A QUEST TO SAVE THE OYSTER REEF
Teacher Guide

Grade Level: 9-12

Learning Objectives:
- To biologically describe the characteristics of the American oyster.
- To understand how oyster reefs develop.
- To describe the economic and biological importance is of the oyster reef.
- To list factors that have threatened the oyster reef population.
- To identify methods being used to prevent the decline in oyster populations.
- To propose new regulations that could slow or stop the decline in the oyster reef population.

Guiding Question:
What is the economic and biological importance is of the oyster reef, how are oyster reef populations threatened, and what can be done to prevent this decline?

Materials:
Student worksheet with guided questions
Characterization of the Ashepoo-Combahee-Edisto (ACE) Basin, South Carolina CD-ROM
Copies of the CD-ROM information (if computers are not available)

Audio/Visual Equipment:
Computer with LCD projector or TV monitor
Internet access

Teaching Time: 90 minutes (2 45-minute periods)

Seating arrangement:
Individuals in computer lab or at desks

Maximum Number of Students: 30

Keywords:
bivalve
mantle
intertidal
broadcast spawner
protandric
planktonic
trochophore larvae
pediveliger
spat
spatfall
filter feeder
phytoplankton

Background Information:

Introduction

There has been a reduction in the success of the local oyster harvesters on the island of Wando Fooka. The tourists who come to this island to eat the wonderful oysters have not shown up. In addition, the local residents have had to order oysters from "off" for their traditional oyster roasts. It is up to you to discover what is causing this problem.

The Task

You are a noted marine biologist whose assignment is to uncover what is causing the decline in the oyster population and propose a solution to the problem. To do this, it will be necessary for you to understand what an oyster is, how oyster reefs develop, what the economic and biological importance is of the oyster reef, and how oyster reef populations are threatened.

Learning Procedure:

The Process

The first thing you should do is familiarize yourself with the American oyster by reviewing the CDROM and the websites and answering the following questions.

1. What is the scientific name for the Eastern or American Oyster?
   Crassostrea virginica

2. Describe the anatomy of an oyster.
   The oyster is a mollusk with two shells joined by a hinge (bivalve). In cluster-forming oysters, the left valve is curved and thicker than the right valve. The shell is secreted by the mantle, which also serves to protect the internal organs. The seawater filled mantle cavity prevents the oyster from drying out during low tide.

3. Where do oyster reefs develop in South Carolina?
   Shallow water in intertidal zones.

4. Name three conditions that support oyster bed establishment.
   Firm substrates with high salinity, sufficient food, and moderate siltation.

5. Describe two factors that influence spawning activities of oysters.
   Temperature and salinity

6. Why are oysters considered "broadcast" spawners?
   They eject sperm and eggs into the water for external fertilization. Females release eggs when sperm is present.

7. Define the term protandric.
   Oysters develop first as males and later develop ovaries and become female.

8. Describe the development of oyster larvae.
   The fertilized eggs develop into larvae that are planktonic (free-floating). The last larval stage (pediveliger) finds a suitable site to settle, such as another oyster shell, rocks, or glass. At this point, the larvae change from free-floating to sessile (immobile) and are called "spat."

9. Explain how oyster reefs are formed.

Larvae may settle on existing oyster shell as a substrate, thus forming oyster reefs or beds. These areas may be selected due to proper resources necessary for survival.

10. Why is an oyster called a filter feeder?
    They consume nutrients and release wastes by filtering water over their gills.

11. What is the main diet of the oyster?
    Phytoplankton, single to multicellular algae

12. Describe the commercial and recreational importance of the American oyster.
    It is the only oyster species on the East Coast and is an important food source. Many people harvest these delicacies recreationally as well.

13. Describe the ecological importance of the oyster.
    The oyster improves water quality by filtering pollutants and sediments from the water. The reefs provide a habitat for a wide range of other animals. The reefs also help stabilize the marsh edges and prevent erosion. Oysters also provide food for birds.

14. What factors are threatening the South Carolina oyster population?
    Over-harvesting, pollutants, and diseases, such as *Perkinsus marinus*, MSX, and Seaside disease are responsible for the decline in the oyster population.

15. What is being done to help the declining South Carolina population?
    See the following website:

16. Now it is your turn to make a plan of action to save the Wando Fooka economy. Propose at least two new regulations that the Wando Fooka officials or public service groups can institute to slow or stop the decline in the oyster reef population.
    Students should propose original regulations. These could range from public awareness programs to governmental laws. Accept all well planned answers.

What this means to me?

Upon completion of this assignment, you should have learned a considerable amount about oysters and oyster reefs. You now understand what an oyster reef is and how important they are to the Lowcountry's ecosystem. You have also learned about several factors that threaten the oyster reefs and about different preventative measures being employed to protect the oyster population. It is important for us all to be aware of human impact on the delicate ecosystems of our communities and to do our part so these resources will be available for future generations. As part of the South Carolina Oyster Restoration (SCORE) project, you will have the chance to assist in the preservation of this vital resource. Congratulations. Job well done!

Assessment:

The grade of your project will be determined by the following:

75% Completion of questions 1-15. Answers should be thorough and in complete sentences.

25% Propose at least two new regulations that the Wando Fooka residents can put into affect that would slow or end the decline in the oyster reef population.

Adaptations:

- This activity can be performed without internet or computer access by printing out the appropriate pages from the resources and copying them for students.
- Students can work as a scientific team in groups of two and complete the activity by giving a presentation to the class about their new regulations they would put in effect.

Resources:

Characterization of the Ashepoo-Combahee-Edisto (ACE) Basin, South Carolina CD-ROM
http://www.cheseapeakebay.net/american_oyster.htm
http://www.dnr.state.sc.us/marine/mrri/shellfish/index.htm

Cross-curricular Connections:

History: Have the students research the history of shellfishing in their area to determine how the collection practices have changed and the impact of the declining population.

Math: Have the students calculate the rate of decline in the oyster population in their area or in the Chesapeake Bay area. In addition have the students compare this to the annual harvesting rate of these same area.

English: Students can write a short story about the life of an oyster in an oyster bed. Have the older students read these stories to a class of younger students.

Art: Students can make murals of the oyster reef and its inhabitants.

Science Extensions:

- Complete biological information by dissecting an oyster.
- Follow up with trip to oyster bed. Do survey of animals that live in the oyster bed.
- Design an in-class oyster aquarium. Have the students grow the algae to feed the oysters.
- Become part of an oyster restoration project. Have the students monitor the spatfall and developing oyster reefs.

South Carolina Curriculum Standards: Grades 9-12

II. Life Science

A. The Cell

5. Cells can differentiate and complex multicellular organisms are formed as a highly organized arrangement of differentiated cells. In the development of these multicellular organisms, the progeny from a single cell form an embryo in which the cells multiply and differentiate to form the many specialized cells, tissues and organs that comprise the final organism. This differentiation is regulated through the expression of different genes.

a. Illustrate the development of an animal multicellular organism (cells, specialized cells, tissues, organs, organ systems, and organisms).

b. Describe how organs and systems in animals function.*

c. Recognize that a degenerative disease involves the deterioration of the organs or tissues.

D. Interdependence of Organisms

1. The atoms and molecules on the earth cycle among the living and nonliving components of the biosphere.

a. Analyze how organisms interact with the biosphere as part of the geochemical cycles (carbon, nitrogen, phosphorous, and water cycles)..

2. Energy flows through ecosystems in one direction, from photosynthetic organisms to herbivores to carnivores and decomposers.

a. Trace the flow of energy through various trophic levels.

3. Organisms both cooperate and compete in ecosystems. The interrelationships and interdependencies of these organisms may generate ecosystems that are stable for hundreds or thousands of years.

b. Evaluate how interrelationships and interdependencies of living things contribute to the homeostasis of ecosystems.

4. Living organisms have the capacity to produce populations of infinite size, but environments and resources are finite. This fundamental tension has profound effects on the interactions between organisms.

a. Describe and give examples of demographic characteristics of populations (e.g., birth and death rates, age structure, and sex ratio).

b. Give examples and explain how limiting factors such as water, food, oxygen and living space play a role in the stability of ecosystems.

c. Predict how interactions among organisms, such as predation, competition, and parasitism affect population growth.

e. Evaluate dynamic equilibria as a result of checks and balances within populations, communities, and ecosystems.

5. Human beings live within the world's ecosystems. Increasingly, humans modify ecosystems as a result of population growth, technology, and consumption. Human destruction of habitats through direct harvesting, pollution, atmospheric changes, and other factors is threatening current global stability, and if not addressed, ecosystems will be irreversibly affected.

a. Identify events that led to awareness of environmental concerns such as fish kills, destruction of the ozone layer, global warming, and decline of the bald eagle. **(H)**

b. Discuss the conflicts that could occur between land developers and conservationists. **(P)**

c. Debate the consequences of extinction and introduction of species within ecosystems.

F. Behavior and Regulation

2. Organisms have behavioral responses to internal change and external stimuli. Responses to external stimuli can result from interactions with the organism's own species and other, as well as environmental changes; these responses can be either innate or learned. The broad patterns of behavior exhibited by animals have evolved to ensure reproductive success. Animals often live in unpredictable environments, and so their behavior must be flexible enough to deal with uncertainty and change. Plants also respond to stimuli.

a. Investigate how different organisms maintain homeostasis.

b. Give examples of feedback mechanisms.

c. Explain how organisms react to pathogens.

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12. Describe the commercial and recreational importance of the oyster.
13. Describe the ecological importance of the oyster.
14. What factors are threatening the South Carolina oyster population?
15. What is being done to help the declining South Carolina population?

16. Now it is your turn to make a plan of action to save the Wando Fooka economy. Propose at least two new regulations that the Wando Fooka officials or public service groups can institute to slow or stop the decline in the oyster reef population.

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